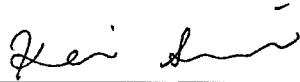


**Translation Verification Statement**

I, Kei SHIMIZU,  
of c/o PREZIO IP Firm, Daikanyama TK Bldg. 1F, 2-17-16, Ebisu-Nishi, Shibuya-ku,  
Tokyo 150-0021 Japan, hereby declare that I am conversant with the Japanese and the  
English languages and that I am the translator of the documents attached and certify that  
to the best of my knowledge and belief the following is a true and correct translation of  
the certified copy of Japanese Patent Application No. 2003-083937 filed on March 25,  
2003, in the name of Sumitomo Bakelite Co., Ltd.



(Signature)

Signed by Kei SHIMIZU  
(printed name)

Date March 6, 2007

Filing Date: March 25, 2003

Ref.:POE03309

Pat. Appln. No.2003-083937

[DOCUMENT NAME] Application for Patent

[REFERENCE NO.] POE03309

[APPLICATION DATE] March 25, 2003

[DESTINATION] Commissioner, Patent Office

[INTERNATIONAL PATENT CLASSIFICATION] C08L 63/00

H01L 23/29

[INVENTOR]

[ADDRESS] c/o Sumitomo Bakelite Co., Ltd.

5-8, Higashi-Shinagawa 2-chome, Shinagawa-ku, Tokyo

[NAME] Shigehisa UEDA

[INVENTOR]

[ADDRESS] c/o Sumitomo Bakelite Co., Ltd.

5-8, Higashi-Shinagawa 2-chome, Shinagawa-ku, Tokyo

[NAME] Kuniharu UMENO

[APPLICANT FOR PATENT]

[IDENTIFICATION NO.] 000002141

[ADDRESS] 5-8, Higashi-Shinagawa 2-chome, Shinagawa-ku, Tokyo

[NAME] Sumitomo Bakelite Co., Ltd.

[REPRESENTATIVE] Tsuneo MORIYA

[DESIGNATION OF CHARGE]

[LEDGER NO. FOR PREPAYMENT] 003539

[AMOUNT OF PAYMENT] 21000

[LIST OF DOCUMENT SUBMITTED]

[OBJECT NAME] Specification 1

[OBJECT NAME] Abstract 1

[PROOF] Required

[DOCUMENT NAME] SPECIFICATION

[TITLE OF THE INVENTION] EPOXY RESIN COMPOSITION AND SEMICONDUCTOR DEVICE

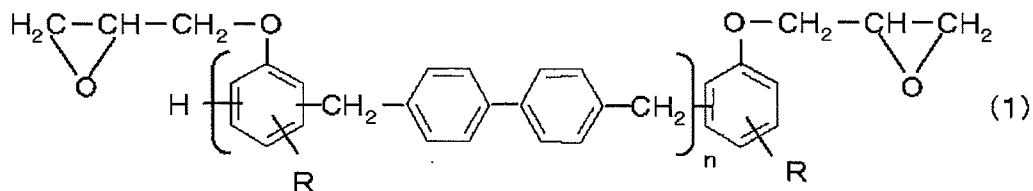
[CLAIMS]

[CLAIM 1]

An epoxy resin composition for encapsulating a semiconductor chip comprising:

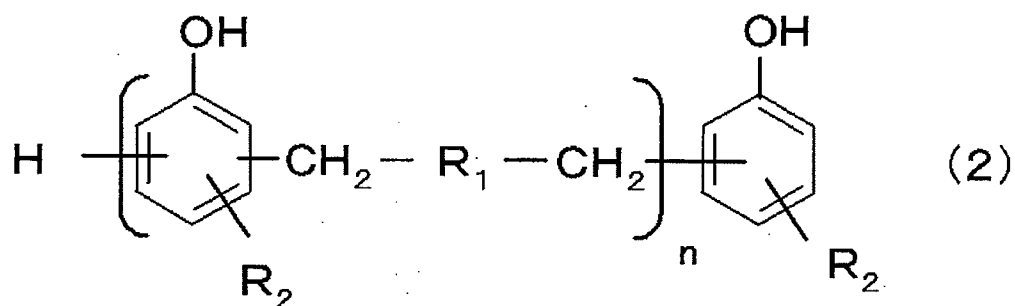
an epoxy resin (A) represented by general formula (1), a phenol resin (B) represented by general formula (2), an inorganic filler (C) in 84 wt% to 90 wt% of the total amount of the epoxy resin composition, a curing accelerator (D) as main components, comprising, a silane coupling agent (E) in 0.01 wt% to 1.0 wt% of the total amount of the epoxy resin composition, and compound (F) which contains two or more hydroxyl groups combined with each of adjacent carbon atoms comprising an aromatic ring, and may or may not contain a substituent other than the hydroxyl groups in 0.01 wt% to 0.5 wt% of the total amount of the epoxy resin composition.

[Chem.1]



(R represents a hydrogen or an alkyl group having equal to or less than four carbon atoms; and n is a number from 0.5 to 5.)

[Chem.2]



(R<sub>1</sub> represents a phenylene group or a biphenylene group; R<sub>2</sub> represents an alkyl group having equal to or less than four carbon atoms; and n is a number from 0.5 to 5.)

[CLAIM 2]

A semiconductor device wherein a semiconductor chip is encapsulated by the use of the epoxy resin composition according to Claim 1.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[FIELD OF THE INVENTION]

This invention relates to an epoxy resin composition for encapsulating a semiconductor chip and a semiconductor device therewith.

[0002]

[BACKGROUND OF THE INVENTION]

Recently, epoxy resin compositions have been predominantly used for encapsulating a semiconductor chip because of their good balance among productivity, a cost and reliability. Along with reduction in a size and a thickness in a semiconductor device, an epoxy resin composition for encapsulating with a lower viscosity and higher strength has been needed. Furthermore, in terms of environmental concerns, it has been increasingly needed to make a device fire-resistant without a fire retardant such as Br compounds and antimony oxide. From such a situation, there has been recently a distinctive tendency to employing a less viscous resin and adding more

inorganic fillers to an epoxy resin composition. As a new trend, a semiconductor device has been more frequently mounted using an unleaded solder with a higher melting point than a conventional solder. For applying such a solder, a mounting temperature must be higher by about 20 °C than a conventional temperature, and thus a mounted semiconductor device becomes considerably less reliable than a device of the related art. Therefore, the need for improving reliability in a semiconductor device by providing a higher-level epoxy resin composition has increasingly become stronger, which further accelerates reducing a resin viscosity and increasing the amounts of inorganic fillers.

[0003]

As well-known technique, a low viscosity and a high flowability during molding can be maintained by using a resin with a lower melt viscosity (Patent document 1) or by surface-processing inorganic fillers with a silane coupling agent for increasing the amounts of the inorganic fillers (Patent document 2). However, any of these methods cannot simultaneously meet all requirements of crack resistance, higher flowability and fire resistance. Thus, there has been needed technique in which a resin with improved crack and fire resistance can be used and the amounts of inorganic fillers can be increased to sufficiently improve reliability without deterioration in flowability or curing property.

[0004]

[PATENT DOCUMENT 1] Japanese Patent Laid-Open NO. H07-130919 (pp. 2-5)

[PATENT DOCUMENT 2] Japanese Patent Laid-Open NO. H08-20673 (pp. 2-4)

[0005]

[PROBLEM TO BE SOLVED BY INVENTION]

In this invention, an epoxy resin composition for

encapsulating a semiconductor chip, which has good flowability without deterioration in curability during molding is provided.

[0006]

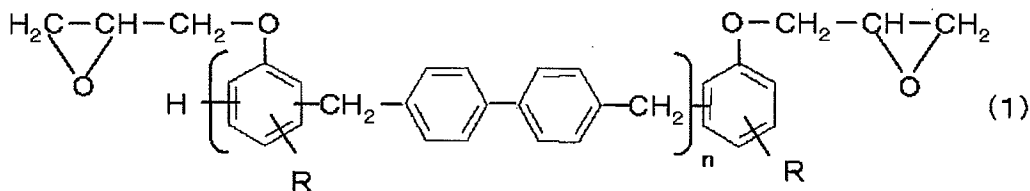
[MEANS FOR SOLVING PROBLEM]

This invention provides

[1] a epoxy resin composition for encapsulating a semiconductor chip comprising: an epoxy resin (A) represented by general formula (1) and a phenol resin (B) represented by general formula (2) and an inorganic filler (C) in 84 wt% to 90 wt% of the total amount of the epoxy resin composition and a curing accelerator (D) as main components, comprising a silane coupling agent (E) in 0.01 wt% to 1 wt% of the total amount of the epoxy resin composition and Compound (F) which contains two or more hydroxyl groups combined with each of adjacent carbon atoms comprising an aromatic ring, and may or may not contain substituent other than the hydroxyl groups in 0.01 wt% to 0.5 wt% of the total amount of the epoxy resin composition:

[0007]

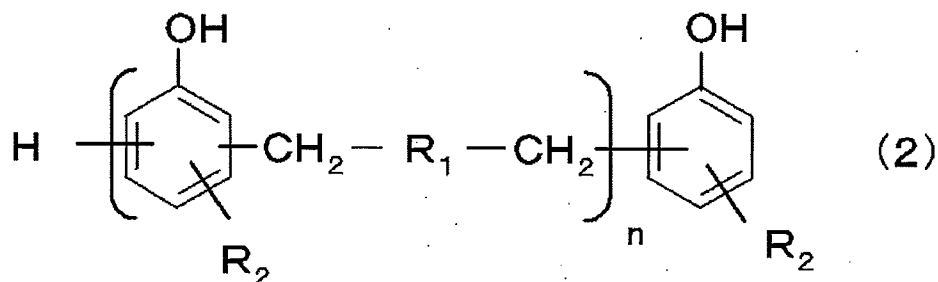
[Chem.3]



(R represents a hydrogen or an alkyl group having equal to or less than four carbon atoms; and n is a number from 0.5 to 5.)

[0008]

[Chem.4]



(R<sub>1</sub> represents a phenylene group or a biphenylene group; R<sub>2</sub> represents an alkyl group having equal to or less than four carbon atoms; and n is a number from 0.5 to 5); and

[0009]

[2] a semiconductor device wherein a semiconductor chip is encapsulated by the use of the epoxy resin composition described the above [1].

[0010]

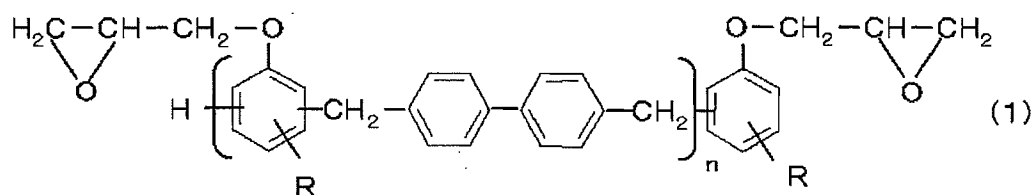
#### [EMBODIMENT OF THE INVENTION]

There will be described each component.

The epoxy resin represented by general formula (1) used in this invention has a hydrophobic and rigid biphenylene structure within an epoxy group thereof. Thus, a cured product of the epoxy resin composition comprising the resin has a lower coefficient of moisture absorption and a lower elastic modulus in a high-temperature range higher than a glass-transition temperature (hereinafter, referred to as "Tg"), and exhibits good adhesiveness to a semiconductor chip, an organic substrate and a metal substrate. It also exhibits good fire retardancy and has a feature that it exhibits relatively higher heat resistance with respect to its low crosslinking density. The epoxy resin (A) used in this invention represented by general formula (1) may include, for example, phenol-biphenylalkyl type epoxy resins, but those having the structure of formula (1) may be used without limitations. In this invention the epoxy resin

represented by general formula (1) may be combined with another epoxy resin as long as the effects of the former resin are not deteriorated. An epoxy resin which can be combined include, for example, biphenyl type epoxy resins, bisphenol type epoxy resins, stilbene type epoxy resins, phenol novolac type epoxy resins, cresol novolac type epoxy resins, triphenolmethane type epoxy resins, phenolaralkyl type epoxy resins, naphthol type epoxy resins, alkyl-modified triphenolmethane type epoxy resins, triazine-structure containing type epoxy resins and dicyclopentadiene-modified type phenol epoxy resins or the like. In the light of moisture-resistance reliability as an epoxy resin composition for encapsulating a semiconductor chip, it is preferable that Na and Cl ions as ionic impurities exit as little as possible. In view of curability, it is preferable an epoxy equivalent may be 100 g/eq to 500 g/eq.

[Chem.5]



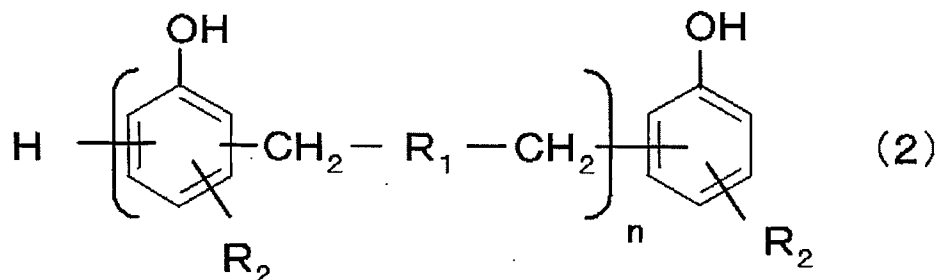
[0011]

The phenol resin represented by general formula (2) used in this invention has a hydrophobic phenylene group or hydrophobic and rigid biphenylene structure within a phenolic hydroxyl group thereof. Thus, a cured product of the epoxy resin composition comprising the resin has a lower coefficient of moisture absorption and a lower elastic modulus in a high-temperature range higher than a Tg, and exhibits good adhesiveness to a semiconductor chip, an organic substrate and a metal substrate. It also exhibits good fire retardancy and has a feature that it exhibits



relatively higher heat resistance with respect to its low crosslinking density. The phenol resin used in this invention represented by general formula (2) may include, for example, phenol biphenylaralkyl resins and phenolaralkyl resins, but those having the structure of formula (2) may be used without limitations. In this invention, the phenol resin represented by general formula (2) may be combined with another phenol resin as long as the effects of the former phenol resin are not deteriorated. A phenol resin which can be combined include, for example, phenol novolac resins, cresol novolac resins, triphenolmethane resins, terpene-modified phenol resins, dicyclopentadiene-modified phenol resins and naphtholaralkyl resins (including a phenylene or biphenylene structure) or the like. In the light of curability, a hydroxyl equivalent may be preferably 90 g/eq to 250 g/eq.

[Chem. 6]



[0012]

An inorganic filler (C) used in the invention generally include fused silica, spherical silica, crystal silica, alumina, silicon nitride and aluminum nitride and the like, which are commonly used for an encapsulating material. It is preferred that a particle size of the inorganic filler may be 0.01  $\mu\text{m}$  to 150  $\mu\text{m}$  in the light of filling properties into a mold. A filling amount of the inorganic filler (C) may preferably be 84 wt% to 90 wt% of the total amount of

an epoxy resin composition, and if it is less than lower limit, water absorption by a cured product of the epoxy resin composition may be increased, leading to deterioration in strength and thus insufficient solder resistance, while if it is more than upper limit, flowability may be deteriorated, leading to deterioration in moldability unfavorably.

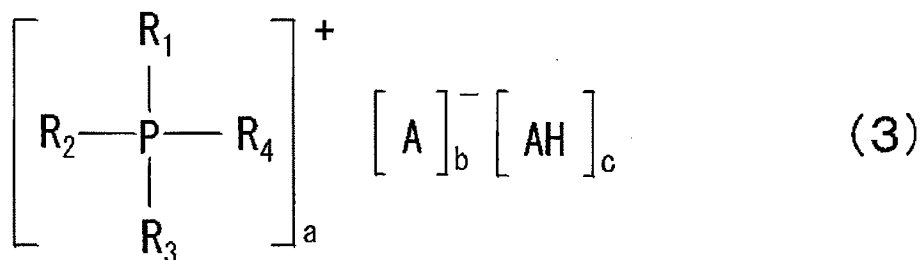
[0013]

The curing accelerator (D) used in the invention may be any compound which can accelerate a reaction between an epoxy group in an epoxy resin and a hydroxyl group in a phenol resin, and may be selected from those commonly used in an epoxy resin composition as an encapsulating material for a semiconductor chip. Specific examples include phosphorous-containing compounds such as organophosphines, tetra-substituted phosphonium compounds and phosphobetaine compounds; and nitrogen-containing compounds such as 1,8-diazabicyclo(5,4,0)undecene-7, benzyldimethylamine and 2-methylimidazole. Examples of an organophosphine include primary phosphines such as ethylphosphine and phenylphosphine; secondary phosphines such as dimethylphosphine and diphenylphosphine; tertiary phosphines such as trimethylphosphine, triethylphosphine, tributylphosphine, and triphenylphosphine. A tetra-substituted phosphonium compound may be a compound represented by general formula (3). The compound represented by general formula (3) may be prepared as follows. First, a tetra-substituted phosphonium bromide, an aromatic organic acid and a base are combined in an organic solvent and homogeneously mixed to generate aromatic organic acid anions in the solution system. Then, by adding water, the compound represented by general formula (3) may be precipitated. Preferably, a compound represented by general formula (3) is a compound wherein  $R_1$ ,  $R_2$ ,  $R_3$  and

$R_4$  bound to phosphorous are phenyl groups, and AH is a compound having a hydroxyl group in an aromatic ring, that is, phenols; and A is preferably an anion of the phenols. A phosphobetaine compound may be a compound represented by general formula (4). The compound represented by general formula (4) may be prepared as follows. First, an iodophenol and a triaromatic-substituted phosphine are homogeneously mixed in an organic solvent and by using a nickel catalyst, a product is precipitated as an iodonium salt. The iodonium salt and a base may be homogeneously mixed in an organic solvent and water may be, if necessary, added to precipitate the compound represented by general formula (4). As for the compound represented by general formula (4), it is preferred that X is a hydrogen or a methyl group, and Y is a hydrogen or a hydroxyl group, however it is not limited to these, and it may be used alone or in combination of two or more. An amount of the curing accelerator used in this invention may be preferably 0.1 wt% to 0.6 wt% of the total amount of an epoxy resin composition, and if it is less than lower limit, desired level of curability may not be obtained, while if it is more than upper limit, flowability may be deteriorated unfavorably.

[0014]

[Chem. 7]

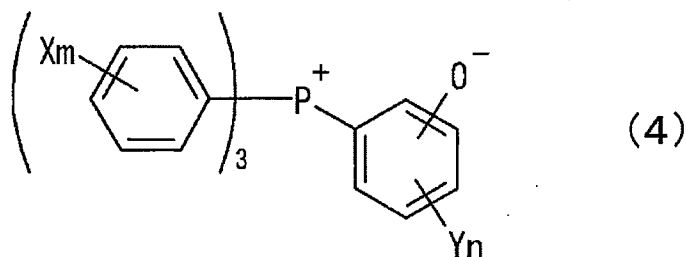


(P is a phosphorous atom;  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_4$  are substituted or unsubstituted aromatic or an alkyl group; A is an anion of an aromatic organic acid having

a functional group selected from a hydroxyl, a carboxyl and a thiol group in the aromatic ring; AH is an aromatic organic acid having at least one selected from a hydroxyl, a carboxyl and a thiol group in the aromatic ring; a, b and c are an integer of 1 to 3, and provided that a = b.)

[0015]

[Chem. 8]



(X is a hydrogen or an alkyl group having 1 to 3 carbon atoms; Y is a hydrogen or a hydroxyl group; m and n are an integer of 1 to 3.)

[0016]

The silane coupling agent (E) may be epoxysilanes, aminosilanes, ureidosilanes and mercaptosilanes. However, it may be, without limitations, any one which can be reacted between an epoxy resin composition and an inorganic filler to improve interface strength between the epoxy resin composition and the inorganic filler. Compound (F) containing two and more hydroxyl groups combined with each of adjacent carbon atoms comprising an aromatic ring, and may or may not contain substituent other than the hydroxyl groups (hereinafter, referred to as "Compound (F)"), significantly improves viscosity and flow properties by synergistic effect with a silane coupling agent (E). The silane coupling agent (E) is essential for adequate effects of Compound (F). These silane coupling agents (E) may be used alone or in combination of two or more. An amount of the silane

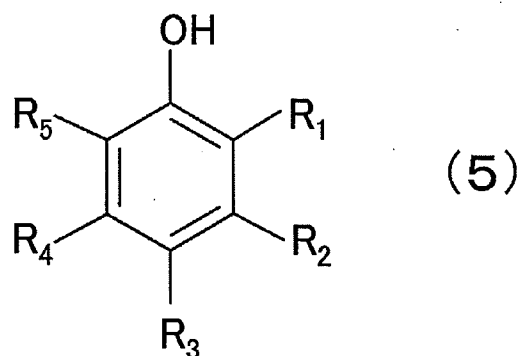
coupling agent (E) may be 0.01 wt% to 1 wt%, preferably 0.05 wt% to 0.8 wt%, more preferably 0.1 wt% to 0.6 wt% of the total amount of an epoxy resin composition, and if it is less than lower limit, compound (F) may not be adequately effective and solder resistance of a semiconductor package may be deteriorated, if it is more than upper limit, an epoxy resin composition becomes so water-absorptive that unfavorably solder resistance in a semiconductor package may be also deteriorated.

[0017]

Compound(F) containing two and more hydroxyl groups combined with each of adjacent carbon atoms comprising an aromatic ring, and may or may not contain a substituent other than the hydroxyl groups (hereinafter, referred to as "Compound (F)"), preferably represented by general formula (5) or (6). Examples of above compound include catechol, pyrogallol, gallic acid, gallic acid esters, 1,2-dihydroxynaphthalene, 2,3-dihydroxynaphthalene and their derivatives. In particular, the above compound preferably has a core ring may be preferably a naphthalene ring (1,2-dihydroxynaphthalene, 2,3-dihydroxynaphthalene and their derivatives), which contributes to easy control and lower volatility. The compounds as Compound (F) may be used in combination of two or more. An amount of Compound (F) may be 0.01 wt% to 0.5 wt%, preferably 0.02 wt% to 0.3 wt% of the total amount of an epoxy resin composition, if it is less than lower limit, expected viscosity or flow properties by synergetic effect with a silane coupling agent (E) may not be obtained, while if it is more than upper limit, curing of the epoxy resin composition may be inhibited, leading to deteriorated physical properties of a cured product and thus deterioration in its unfavorabl performance as a resin for encapsulating a semiconductor chip.

[0018]

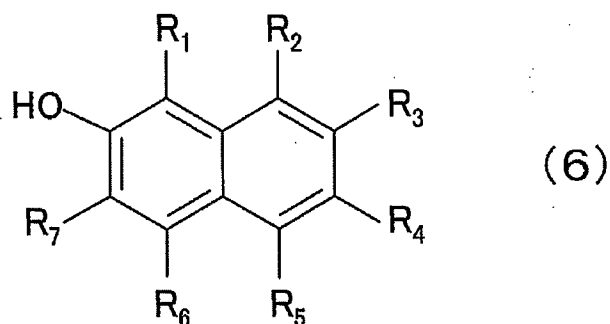
[Chem. 9]



(One of R<sub>1</sub> and R<sub>5</sub> is a hydroxyl group and when one is a hydroxyl group, the other is a hydrogen, a hydroxyl group or a substituent other than a hydroxyl group; and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are a hydrogen, a hydroxyl group or a substituent other than a hydroxyl group.)

[0019]

[Chem. 10]



(One of R<sub>1</sub> and R<sub>7</sub> is a hydroxyl and when one is a hydroxyl group, the other is a hydrogen, a hydroxyl group or a substituent other than a hydroxyl group; and R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub> and R<sub>6</sub> are a hydrogen, a hydroxyl group or a substituent other than a hydroxyl group.)

[0020]

Although an epoxy resin composition according to this invention includes the above components (A) to (F) as essential components, it may further contain, if necessary, additives including a fire retardant such as a brominated epoxy resin and antimony trioxide; a

mold release; a coloring agent such as carbon black; a low-stress additive such as silicone oil and silicone rubber; and an inorganic ion exchanger as appropriate.

An epoxy resin composition according to this invention may be prepared by homogeneously mixing components (A) to (F) and other additives in a mixer at a normal temperature, followed by melt-kneading using an appropriate apparatus such as a heating roller, kneader or extruder, cooling and then grinding.

For encapsulating a semiconductor chip using an epoxy resin composition according to this invention to provide a semiconductor device, the composition may be molded and cured by an appropriate molding process such as transfer molding, compression molding and injection molding.

[0021]

This invention will be more specifically described with reference to, but not limited to, Examples as follows. Throughout this disclosure, a blending ratio is presented as parts by weight.

#### FIRST EMBODIMENT

A phenol biphenylaralkyl type epoxy resin (Nippon Kayaku Co., Ltd., NC3000-P, epoxy equivalent: 274, "n" in formula (1) is 2.8 as an average, softening point: 58 °C): 7.35 wt parts;

phenol biphenylaralkyl resin (Meiwa Kasei Co., Ltd., MEH-7851SS, hydroxyl equivalent 203, "n" in formula (2) is 2.5 as an average, softening point: 65 °C): 5.5 wt parts;

spherical fused silica (average particle size: 30 µm): 86.0 wt parts;

γ-glycidylpropyl-trimethoxysilane: 0.4 wt parts;

triphenyl phosphine: 0.2 wt parts;

2,3-dihydroxynaphthalene (Reagent grade): 0.05 wt parts;

carnauba wax: 0.2 wt parts; and

carbon black: 0.3 wt parts

were mixed in a mixer at an ambient temperature, followed by melt kneading by a heating roller at 80 to 100 °C, cooling and then grinding to obtain an epoxy resin composition. The evaluation results are shown in Table 1.

[0022]

Spiral flow; the epoxy resin composition was molded by a low-pressure transfer molding machine under the conditions of a temperature: 175 °C, a molding pressure: 6.9 MPa and a pressure keeping time: 120 sec, using a mold in accordance with EMMI-1-66, and then a spiral flow was determined. A spiral flow is a parameter for flowability. The larger the parameter is, the better flowability is. A unit is "cm".

Curing torque ratio: Using a curastometer (Orientec Inc., JSR Curastometer Type IVPS), a torque was determined after 90 and 300 sec from initiation of heating at a mold temperature of 175 °C and a curing torque ratio = (torque after 90 sec) / (torque after 300 sec) was calculated. A torque determined by a curastometer is a parameter for thermal rigidity. The larger the curing torque ratio is, the better curability is. A unit is "%".

Solder resistance-reflow cracking: using a low-pressure transfer molding machine, a 100pQFP frame (Cu frame) with a body size of 14 × 14 × 1.4 mm to which an Si chip with a size of 6 × 6 × 0.30 mm is adhered was molded under the conditions of a mold temperature: 175 °C, an injection time: 10 sec, a curing time: 90 sec and an injection pressure: 9.8 MPa. After post-curing at 175°C for 8 hrs, it was humidified under the condition of 85 °C and 85 % for 48 hrs and passed through an IR reflow at a peak temperature of 260 °C consecutive three times (three times, 10 sec at 255 °C or higher for each run). Then, it was examined for internal cracks and delaminations using an ultrasonic test equipment. Evaluation was based on the numbers



of delaminations of the chip and internal cracks in 10 packages.

Fire retardancy: using a low-pressure transfer molding machine, test pieces for fire retardancy with a thickness of 3.2 mm were prepared under the conditions of a mold temperature: 175 °C, an injection time: 15 sec, a curing time: 120 sec, and an injection pressure: 9.8 MPa and was tested for fire retardancy in accordance with the specification of UL94.

[0023]

*EMBODIMENTS 2 TO 13 AND COMPARATIVE EXAMPLES 1 TO 15*

According to the blending ratios shown in Tables 1 and 2, epoxy resin compositions were prepared and evaluated as described in Example 1. The evaluation results are shown in Tables 1 and 2.

Components used other than those in Example 1 are as follows.

A biphenyl type epoxy resin (Japan Epoxy Resin Inc., YX4000H, epoxy equivalent: 195, melting point: 105 °C);

phenolaralkyl resin (Mitsui Chemicals Inc., XLC-LL, hydroxyl equivalent: 174, "n" in formula (2) is 3.6 as an average, softening point: 79 °C);

a cresol novolac type epoxy resin (Nippon Kayaku Co., Ltd., EOCN 1020-55, epoxy equivalent: 198, softening point: 55 °C);

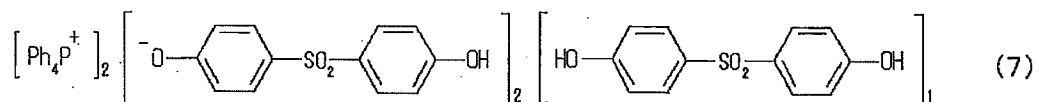
phenol novolac resin (hydroxyl equivalent: 104, softening point: 80 °C);

$\gamma$ -mercaptopropyltrimethoxysilane;

1,8-diazabicyclo(5,4,0)undecene-7 (hereinafter, referred to as "DBU");

[0024]

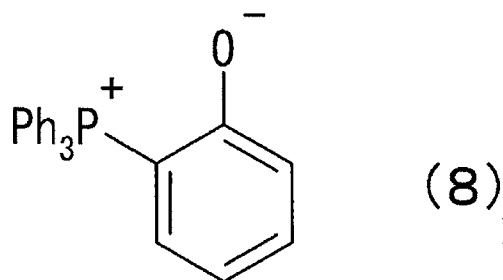
a curing accelerator represented by formula (7);  
[Chem. 11]



[0025]

a curing accelerator represented by formula (8);

[Chem. 12]



[0026]

1,2-dihydroxynaphthalene (Reagent grade);

catechol (Reagent grade);

pyrogallol (Reagent grade);

1,6-dihydroxynaphthalene (Reagent grade); and

resorcinol (Reagent grade).

[0027]

[TABLE 1]

Table 1

	Example												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Phenol biphenyl/alkyl type epoxy resin	7.35	4.0	8.65	7.5	7.13	7.42	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Eliphenyl type epoxy resin		1.0											
Phenol biphenyl/alkyl resin	5.5	2.5	5.5	5.5	5.3	5.5	5.5	5.5	5.5	5.5	5.5	5.45	5.45
Phenol/alkyl resin		1.3											
Spherical fused silica	86.0	90.0	84.5	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0
$\gamma$ -Glycidypropyltrimethoxysilane	0.4	0.5	0.3	0.05	0.85	0.03	0.4	0.4	0.4		0.4	0.4	0.4
$\gamma$ -Mercaptopropyltrimethoxysilane										0.4			
Triphenylphosphine	0.2	0.13	0.25	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
DBU											0.2		
Curing accelerator of formula (7)												0.25	
Curing accelerator of formula (8)													0.25
2,3-Dihydroxynaphthalene	0.05	0.07	0.1	0.25	0.02	0.35				0.05	0.05	0.05	0.05
1,2-Dihydroxynaphthalene							0.05						
Catechol							0.05						
Pyrogallol									0.05				
1,6-Dihydroxynaphthalene													
Resorcinol													
Carnauba wax	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Carbon black	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Spiral flow	100	95	121	115	96	118	104	99	113	106	102	112	105
Curing torque ratio	65	61	66	60	68	58	63	64	61	63	61	65	69
Solder resistance-cracking	0	0	0	0	0	0	0	0	0	0	0	0	0
Chip delamination	0	0	0	0	0	0	0	0	0	0	0	0	0
Internal crack	0	0	0	0	0	0	0	0	0	0	0	0	0
Fire retardancy	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0

[0028]

[TABLE 2]

Table 2

	Comparative Example														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phenol bisphenylalkyl type epoxy resin	7.4	3.6	9.5	9.4		7.4	7.1	7.5	7.412	7.6	7.35	7.35	7.4	7.35	7.35
Bisphenyl type epoxy resin		0.9													
Cresol novolac type epoxy resin					6.9										
Phenol bisphenylalkyl resin	5.5	2.3	6.35			5.5	5.25	5.52	5.48	5.65	5.5	5.5	5.5	5.5	5.5
Phenolalkyl resin		1.0			6.0										
Phenol novolac resin				3.5											
Spherical fused silica	86.0	91.0	83.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0
7-Glycidylpropyltrimethoxysilane	0.4	0.5	0.3	0.4	0.4		0.4	0.4	0.4		0.4	0.4	0.4	0.4	0.4
7-Mercaptopropyltrimethoxysilane						0.4									
Triphenylphosphine	0.2	0.13	0.25	0.15	0.15	0.2	0.2	0.08	0.2	0.2	0.2	0.2			
DBU													0.2		
Curing accelerator of formula (7)														0.25	
Curing accelerator of formula (8)															0.25
2,3-Dihydroxynaphthalene		0.07	0.1	0.05	0.05		0.55		0.008	0.05					
1,2-Dihydroxynaphthalene															
Catechol															
Pyrogallol															
1,8-Dihydroxynaphthalene											0.05				
Resorcinol												0.05			
Carrauba wax	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Carbon black	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Spiral flow (cm)	80	63	126	76	71	82	118	114	81	76	78	81	68	89	77
Curing torque ratio (%)	65	62	65	67	70	62	22	7	65	56	65	64	57	85	89
Solder resistance-cracking	4	chip exposure	0	2	chip exposure	3	Poor releasing	Poor releasing	1	9	5	4	4	2	3
Chip delamination	0	0	2	10	0	0			0	0	0	0	0	0	0
Internal crack	V-O	V-O	V-1	V-1	HB	V-O			V-O	V-O	V-O	V-O	V-O	V-O	V-O
Fire retardancy	V-O	V-O	V-1	V-1	HB	V-O			V-O	V-O	V-O	V-O	V-O	V-O	V-O

[0029]

[ADVANTAGE OF THE INVENTION]

Following the present invention, an epoxy resin composition Which could not be obtained by the related art having good flowability during molding while maintaining curability is provided.

[DOCUMENT NAME] ABSTRACT OF THE DISCLOSURE

[ABSTRACT]

[OBJECT] Providing an epoxy resin composition for encapsulating a semiconductor chip, which has good flowability without deterioration in curability.

[MEANS TO SOLVE THE PROBLEM] An epoxy resin composition for encapsulating a semiconductor chip which contains a phenol aralkyl type epoxy resin containing biphenylene structure (A), a phenol aralkyl type resin containing phenylene or biphenylene structure (B), an inorganic filler (C) in 84 wt% to 90 wt% of the total amount of the epoxy resin composition and a curing accelerator (D) as main components, comprising a silane coupling agent (E) in 0.01 wt% to 1 wt% of the total amount of the epoxy resin composition and Compound (F) which contains two or more hydroxyl groups combined with each of adjacent carbon atoms comprising an aromatic ring, and may or may not contain substituent other than the hydroxyl groups in 0.01 wt% to 0.5 wt% of the total amount of the epoxy resin composition, and a semiconductor device.